Appendix B

Storage Precaution Signs for Hazardous Chemicals

Copies of the storage precaution signs shown in Figs. B-1, Water Reactive Chemicals;, B-2, Oxidizers; B-3, Pyrophoric Substances; B-4, Toxic Compounds; B-5, Flammables; and B-6, Acids and Bases can be obtained from your ES&H team. These signs should be posted in areas where hazardous chemicals are used.

WATER REACTIVE CHEMICALS

Storage Precautions:

- Store in a cool, dry place.
- In case of fire, keep water away.

WARNING: These chemicals react with water to yield flammable or toxic gases or other hazardous conditions.

Solids

Aluminum choride, anhydrous
Calcium carbide
Calcium oxide
Ferrous sulfide
* Lithium
Magnesium
Maleic anhydride
Phosphorous pentachloride
Phosphorous pentasulfide
* Potassium
* Sodium

* Lithium, potassium, and sodium should be stored under kerosene or mineral oil.

Liquids

Acetyl chloride
Chlorosulfonic acid
Phosphorous trichloride
Silicon tetrachloride
Stannic chloride
Sulfur chloride
Sulfuryl chloride
Thionyl chloride

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Figure B-1. Water Reactive Chemicals.

OXIDIZERS

Storage Precautions:

- Store in a cool, dry place.
- Keep away from flammable and combustible materials (such as paper, wood, etc.).
- Keep away from reducing agents such as zinc, alkaline metals, and formic acid.

Solids

Ammonium dichromate
Ammonium perchlorate
Ammonium persulfate
Benzoyl peroxide
Bromates, salts of [1]
Calcium hypochlorite
Cerric sulfate
Chlorates, salts of [2]
Chromium trioxide
Ferric trioxide
Ferric chloride
Iodates, salts of [3]
Iodine
Magnesium perchlorate
Manganese dioxide
Nitrates, salts of [4]
Periodic acid
Permangic acid
Peroxides, salts of [5]
Potassium dichromate
Potassium ferricyanide
Potassium permanganate
Potassium persulfate
Sodium bismuthate
Sodium chlorite
Sodium dichromate
Sodium nitrite
Sodium perborate
Sulfates, salts of [6]

[1] Potassium bromate, sodium bromate, etc.
[2] Potassium chlorate, etc.
[3] Sodium iodate, etc.
[4] Ammonium nitrate, ferric nitrate, etc.
[5] Lithium peroxide, sodium peroxide, etc.
[6] Ferric sulfate, potassium sulfate, etc.

Liquids

Bromine
Chromic acid
Hydrogen peroxide
Nitric acid
Perchloric acid
Sulfuric acid

Gases

Chlorine
Chlorine dioxide
Fluorine
Nitrogen dioxide
Nitrogen oxide
Oxygen
Ozone

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Figure B-2. Oxidizers.

PYROPHORIC SUBSTANCES

Storage Precaution:

- Store in a cool, dry place.

WARNING: Pyrophoric substances ignite spontaneously upon contact with air.

Boron	* Iron
* Cadmium	* Lead
* Calcium	* Manganese
* Chromium	* Nickel
* Cobalt	† Phosphorous, yellow
Diborane	* Titanium
Dichloroborane	* Zinc
2-Furaldehyde	

* Finely divided metals form a pyrophoric hazard.

† Phosphorous, yellow, should be stored and cut under water.

LIGHT-SENSITIVE CHEMICALS

Storage Precautions:

- Avoid exposure to light.
- Store in amber bottles in a cool, dry place.

Bromine	Mercurous nitrate
Ethyl ether	Oleic acid
Ferric ammonium citrate	Potassium ferrocyanide
Hydrobromic acid	Silver salts[2]
Mercuric salts[1]	Sodium iodide

1 Mercuric chloride, mercuric iodide, etc.

2 Silver acetate, silver chloride, etc.

PEROXIDE-FORMING CHEMICALS

Storage Precautions:

- Store in airtight containers in a dark, cool, and dry place.
- Label containers with receiving, opening, and disposal dates.
- Dispose of peroxide-forming chemicals before expected date of first peroxide formation in accordance with LLNL policy.
- Test for the presence of peroxides periodically.

WARNING: Under proper conditions, these chemicals will form explosive peroxides that can be detonated by shock or heat.

Acetaldehyde	Ethyl ether
Acrylaldehyde	Isopropyl ether
Crotonaldehyde	* Potassium
Cyclohexene	Tetrahydrofuran
p-Dioxane	

* Potassium peroxide often exists in the crust around a chunk of potassium. When cut with a knife, the peroxide rapidly oxidizes the residual kerosene, resulting in an explosion.

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Figure B-3. Pyrophoric Substances.

FLAMMABLES

Storage Precautions:

- Store in approved safety cans or cabinets.
- Segregate from oxidizing acids and oxidizers.
- Keep away from any source of ignition: flames, localized heat, or sparks.
- Safety cans or drums containing flammable liquids should be grounded and bonded when being used.
- Keep firefighting equipment readily available.
- Have spill cleanup materials handy.
- Store highly volatile flammable liquids in a specially equipped refrigerator.

Solids

Benzoyl peroxide
Calcium carbide
Phosphorous, yellow
Picric acid

Liquids

Acetaldehyde
Acetone
Acetyl chloride
Allyl alcohol
Allyl chloride
N-amyl acetate
N-amyl alcohol
Benzene
N-butyl acetate
N-butyl alcohol
N-butylamine
Carbon disulfide
Chlorobenzene
Cyclohexane
Diethylamine
Diethyl carbonate
p-Dioxane
Ethanol
Ethyl acetate
Ethyl acrylate
Ethylamine
Ethyl benzene
Ethylene dichloride
Ethyl ether
Ethyl formate
Furan
Gasoline
Heptane
Hexane
Hydrazine
Isobutyl alcohol
Isopropyl acetate
Isopropyl alcohol
Isopropyl ether
Mesityl oxide
Methanol
Methyl acetate
Methyl acrylate
Methylal
Methyl butyl ketone
Methyl ethyl ketone
Methyl formate
Methyl isobutyl ketone
Methyl methacrylate
Methyl propyl ketone
Morpholine
Naphtha
* Nitromethane
Octane
Piperidine
Propanol
Propyl acetate
Propylene oxide
Pyridine
Styrene
Tetrahydrofuran
Toluene
Turpentine
Vinyl acetate
Xylene

Gases

Acetylene
Ammonia
Butane
Carbon monoxide
Ethane
Ethyl chloride
Ethylene
Ethylene oxide
Formaldehyde
Hydrogen
Hydrogen sulfide
Methane
Propane
Propylene

* Most nitrohydrocarbons are flammable.

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Figure B-4. Flammables.

TOXIC COMPOUNDS

Storage Precaution:

- Store according to hazardous nature of chemical, using appropriate security when necessary.

WARNING: These chemicals are dangerous or extremely dangerous to health and life when inhaled, swallowed, or absorbed by skin contact. Take proper precautionary measures to avoid exposure.

Solids

Antimony compounds
Arsenic compounds
Barium compounds
Beryllium
Cadmium compounds
Calcium oxide
Chromates, salts of
Cyanides, salts of
Fluorides, salts of
Iodine
Lead compounds
Mercuric compounds
Oxalic acid
Phenol
Phosphorous, yellow
Phosphorous pentachloride
Phosphorous pentasulfide
Picric acid
Potassium
Selenium compounds
Silver nitrate
Sodium hydroxide
Sodium hypochlorite

Liquids

Aniline
Bromine
Carbon disulfide
Carbon tetrachloride
Chloroform
Chromic acid
p-Dioxane
Ethylene glycol
Formic acid
Hydrazine
Hydrobromic acid
Hydrochloric acid
Hydrofluoric acid
Hydrogen peroxide
Mercury
Nitric acid
Perchloric acid
Phosphorous trichloride
Sulfuric acid
Tetrachloroethane
Tetrachloroethylene

Gases

Carbon monoxide
Chlorine
Cyanogen
Diborane
Fluorine
Formaldehyde
Hydrogen bromide
Hydrogen chloride
Hydrogen cyanide
Hydrogen sulfide
Nitrogen dioxide
Ozone
Sulfur dioxide

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Figure B-5. Toxic Compounds.

ACIDS

Storage Precautions:

- Store in large bottles of acids on low shelf or in acid cabinets.
- Segregate oxidizing acids from organic acids and flammable and combustible materials.
- Segregate acids from bases and active metals, such as sodium, potassium, magnesium, etc.
- Segregate acids from chemicals that could generate toxic gases upon contact, such as sodium cyanide, iron sulfide, etc.
- Use bottle carriers for transporting acid bottles.
- Have Spill Control Pillows or acid neutralizers available in case of acid spills.

* Acetic acid
* Benzoic acid
* Chloroacetic acid
† Chromic acid
† Hydrobromic acid
Hydrobromous acid
Hydrochloric acid
Hydrochlorous acid
Hydrofluoric acid
Hydroiodic acid
† Iodic acid
Muriatic acid
† Nitric acid
Nitrous acid
† Perchloric acid
* Phenol
Phosphoric acid
Phosphorous acid
* Propionic acid
* Sulfamic acid
* Sulfanilic acid
† Sulfuric acid
Sulfurous acid

* Indicates organic acids.
† Indicates strong oxidizing acids.

BASES

Storage Precautions:

- Segregate bases from acids.
- Store solutions of inorganic hydroxides in polyethylene containers.
- Have Spill Control Pillows or caustic neutralizers available for caustic spills.

Ammonium hydroxide
Bicarbonates, salts of[1]
Carbonates, salts of[2]
Calcium hydroxide
Potassium hydroxide
Sodium hydroxide

[1] Potassium bicarbonate, sodium bicarbonate, etc.
[2] Calcium carbonate, sodium carbonate, etc.

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Figure B-6. Flammables.